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This TOP supersedes TOP 4-2-502, dated 5 May 1978

14. ABSTRACT
Provides a general method of evaluating the safety of munition and demolition items during developmental testing.

15. SUBJECT TERMS
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US ARMY DEVELOPMENTAL TEST COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure (TOP) 4-2-502 17 December 2009
DTIC AD No.

SAFETY TESTING OF ANTIPERSONNEL/ANTITANK MUNITIONS, AND DEMOLITIONS

*This TOP supersedes TOP 4-2-502, dated 5 May 1978.

1. SCOPE.

a. This TOP describes procedures for testing the safety characteristics of munitions and demolitions. The terms munitions and demolitions may also apply to smart munitions which may no longer be considered as basic antipersonnel (AP)/antitank (AT) munitions (sometimes referred as Unmanned Autonomous Munitions). Smart munitions are defined as multi-aspect AT, AP, or special purpose (SP) munitions deployed at or below the surface of the earth, that once armed, react autonomously. Based upon experience and engineering judgment, procedures may be altered to accommodate unique applications or deployment, delivery, and employment methods. This TOP can also be used for testing of newly developed munitions using classic AP/AT munitions as baselines. In particular, this TOP will aid in determining the following characteristics:

(1) The ability of munitions and demolitions to remain safe to use after being subjected to natural and induced environments encountered during storage, handling, transport, and use.

(2) The safety and human health aspects of munitions and demolitions with regard to the users during their planned life cycle.

b. In general, the procedures in this TOP provide the structure necessary to determine whether an item under test, a munition, or a demolition item, is suitable for standard use (ready for production) but do not dictate how an item is to progress through early developmental testing. No sample sizes are suggested in this TOP because they are dependant of the system's statistical reliability requirements. General guidance for testing the ability of munitions and demolitions to safely withstand natural and induced environments encountered during storage, handling, transport, and use is covered within this TOP primarily by reference to TOP 4-2-505[1] and its references.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Item	Requirement
Explosive Test Range	A test site with suitable barricades, shelters, and protection for personnel and equipment; approved for testing of the items under test. Range facilities must have adequate surface danger zone, including overhead air space, for open field testing or specially constructed pits/shelters for closed cell tests. Test Range facilities shall be adequate for testing the functioning of the components, subassemblies, and full-up systems of single munition/demolition item as well as arrays of munitions/demolitions.

**Subscript numbers correspond to references in Appendix C.

Item	Requirement
Environmental Conditioning Chambers	Controlled chambers used to subject the items under test to thermal shock, fungus, dust, solar radiation, and other environments including temperature/humidity and condition the items under test to the desired test temperatures. Record chamber temperature, humidity, and other test parameters on a continuous basis.
Vibration Facility	A test facility used to remotely conduct secured-cargo vibration tests and loose-cargo vibration tests that simulate actual transportation vibration that the items under test are expected to experience during its life cycle. Described in International Test Operations Procedure (ITOP) 1-2-601[2].
Drop Test Facility	A test facility used to remotely subject the items under test to packaged and unpackaged drop tests that the items under test could experience during its life cycle. Described in ITOP 4-2-601[3] and ITOP 4-2-602[4].
X-Ray Facility	A facility approved for handling explosives that is used to conduct X-ray examination of the items under test.
Slow Cook-Off Oven	A disposable oven that is capable of increasing the air temperature at the prescribed rate throughout the anticipated temperature range and maintaining a reasonably uniform temperature in the air around the test items.
Bullet Impact Test Facility	A facility with remotely operated guns and instrumentation for recording the reaction of the items under test to bullet impact. The facility must have appropriate safety equipment as well as high-speed cameras, blast gauges, and velocity radar for recording the test event.
Immersion Chamber	A chamber that subjects the items under test to the effects of immersion in water, including salt water if required. The chamber must be of sufficient depth or have the capability to simulate the depth requirement by the application of pressure.
Operating Equipment	Recovery vehicles and equipment with remote control capabilities for disarming and recovery of live test items.
Electromagnetic Interference (EMI) Chamber	Approved EMI chamber to determine the effects of electromagnetic, electrostatic, and lightning environments on the safety and/or operation of the items under test in accordance with Military Standard (MIL-STD)-461E[5] and MIL-STD-464A[6].

2.2 Instrumentation.

a. Comprehensive photographic (high-speed digital and/or still photography) records of the test, test conditions, and test results should be considered for recording the test details.

b. Blast gauges, accelerometers, transducers, pressure gauges, etc., should be available to monitor the pressure effects and noise levels, if applicable, to the items under test.

c. Meteorological data should be collected before and during each field trial. The following parameters are desirable to good data collection, but not limited to: wind velocity, wind direction, temperatures at various altitudes, precipitation, humidity, and solar loading.

d. The following instrumentation shall be required based on the type of test being conducted.

Devices for Measuring	Permissible Measurement Uncertainty
Temperature (controlled)	±2 °C
Temperature (ambient)	±2 °C
Relative humidity (RH) (controlled)	±5 percent
RH (ambient)	±5 percent
Air pressure	±10 kPa
Drop height	1 percent
Impact angle	±5 percent
Meteorological conditions	As required
Blast overpressure	±10 percent or ±1 dB whichever is larger
Arming time	As required
Bullet fragment velocity	±5 m/sec
Interior damage (X-ray equipment)	As required
Photographic record (high speed, analog or digital)	As required
Velocity (radar equipment)	As required
Geodetics equipment	As required
Signal strength meters	As required
Voltage/Current	As required
Electromagnetic radiation	As described in TOP 1-2-511[7]

All instrumentation will be covered by a valid certificate of calibration, traceable to a National Standard and operated in strict accordance with the manufacturer's handbook.

3. REQUIRED TEST CONDITIONS.

3.1 Test Item Configuration.

In general, the items under test should be tested at the system level; unless it can be shown that system integrity does not contribute to the specific results. Ensure the item to be tested is either full production standard hardware or a representative of production hardware. Use of simulated components for non-explosive components is acceptable provided that they accurately simulate the thermal, confinement, mass, and retention characteristics for their counterparts. When the item differs from the production hardware, describe the configuration in the Test Plan. System level implies that all safe and arming (S&A) devices are in place and that all firing train components are present through the kill mechanisms. Specially instrumented subsystems may be substituted for the kill mechanism to provide a record of the fire pulse via data memory boards, smoke, or other means. Instrumented systems or subsystems are encouraged to enhance quality assurance, in-test inspections, failure analysis or diagnostics, and data acquisition, where it can be shown that results are not compromised or that results are better quantified. The test item configuration to be used shall be specified in detail in the Test Plan and approved by the service review organization. Care should be taken to ensure that integral instrumentation is sufficiently rugged to withstand and operate following natural and induced environments. The electronic or other subassemblies not containing explosives may be mechanically, geometrically, and thermally simulated for any test. Specify the items under test configuration to be used in detail in the Test Plan, and have it approved by the service review organization. If desired, use standard development test items (as opposed to full production standard test items) to allow preliminary assessments. The items under test may be either packaged or unpackaged as agreed by the appropriate service authorities.

3.2 Test Planning.

The general approach to test planning is described in TOP 4-2-505.

a. Safety test planning should be initiated early in the acquisition process to yield the most cost effective approach to decision risk mitigation. Long-lead planning will provide the greatest opportunity to minimize the impact of testing on acquisition costs, the environment, and hazards to test participants.

b. Safety test requirements for the system are derived from military safety and hazard standards and the system specific safety requirements. Generally, there are three sets of tests that are used to assess a system with respect to hazards: insensitive munitions (IM) tests used to assess the vulnerability of a system to unplanned stimuli, hazard classification tests used to classify munitions for transportation and storage purposes, and system specific tests to assess the role of the system's response on vulnerability. In order to minimize the impact of multiple tests on limited resources and avoid test redundancy, IM Test Plans should be tailored to the maximum extent possible, so all three sets of tests can be addressed in a coordinated test program using a minimum number of test samples.

c. Review safety documentation, such as the Safety Assessment Report, from the Materiel Developer (MATDEV) or the manufacturer for the system to be tested to determine whether any potential hazards have been identified which involve field employment of the system or which require special attention during testing. This documentation should include previous safety test reports for the system to be tested as well as safety assessments and analyses based upon engineering tests and modeling and simulation studies. The safety documentation should provide a high confidence that the test items can be safely handled and tested by the test participants in the planned environments.

d. Review all previous test reports of similar or related items to identify existing and potential hazards associated with those items to develop steps/procedures to mitigate or eliminate those hazards.

e. Prepare a thorough Risk Assessment or Standing Operating Procedure (SOP) to include a Job Hazard Analysis (JHA) listing all identified/potential safety hazards associated with the testing of the items under test and their risk levels, and all proposed procedures to mitigate those potential hazards and the residual risk levels. Present the Risk Assessment or SOP to a Hazard Analysis Working Group (HAWG) meeting with all involved test center personnel (tester, safety office, environmental office, range control office, and test support office) to finalize the Risk Assessment or SOP and get it approved prior to test initiation.

f. Prepare a comprehensive Test Plan to define objectives for each subtest with regard to demonstrating the safety of the items under test and to identify any features or performance operations that could cause injury to personnel or damage to property. The Test Plan must include provisions for the tests and environmental conditioning requirements. Data sheets should be designed for each subtest data topic and tailored to the planned functions for the system. The data sheets should be used for recording the test parameters and test results. The appropriate review organization(s) will review and concur in the Test Plan prior to the start of testing. The Test Plan should include the following elements:

(1) Identification of preliminary examinations and test data necessary to certify through an approved safety assessment action that the system is safe to undergo the proposed testing. Develop a life cycle environmental profile (LCEP) using guidance available in other national documents for general applications. Included in the LCEP are the worst case environmental conditions and limits that munitions will encounter throughout the life cycle, such as temperature, humidity, and vibration. Establish appropriate test procedures and quantities based upon the objectives of each subtest with the intent of verifying that the items under test meet the design and performance requirements and satisfies the safety requirements for deployment to field personnel. Subtest selection should be based on the type of munition or demolition system that is being conducted, characteristics of the items under test, and an analysis of possible failure modes. The appropriate service review organization(s) will review and concur in the LCEP prior to the conduct of the tests.

(2) Identification of all potential test item types that will be used for each subtest and specify the quantity of each test type.

(3) Identification of any unique instrumentation or test facilities that will be required. It should be noted if a modified test item or less than fully tactical item will be used to enhance data collection, test specific system functions, support modeling, etc.

(4) If required, the Test Plan may include additional specialized tests that are designed to investigate potentially hazardous conditions and environments identified by hazard analyses performed as part of the system safety program.

(5) Post-firing procedures. The procedures that are to be followed after conducting a test are to be specified for all tests. These should include: methods of locating and inspecting objects and fragments of the test items and targets in order to determine the outcome of the test, photography of specified items after the test, instructions for powering-down equipment, safety checks for functioning of the test item, and specification of procedures for safe removal and ultimate disposal of dangerous material following a test.

g. Personnel. All test personnel must be familiarized with the technical and operational characteristics of the items under test as described in applicable Technical Manuals (TMs), requirement documents, or manufacturer's literature. All test personnel must read, sign, and understand all warnings/precautions detailed in the approved Risk Assessment or SOPs prior to commencing the safety evaluation.

h. Sample Size. The selection of an acceptable sample size for safety testing will depend on the characteristics of the items under test and the experimental data available on its expected performance. The minimum sample size will be based on requirements and test item cost consideration. Decision on sample size selection for significant results will be carefully defined and planned. The sample must be of adequate size, it must be "big enough" that an effect of such magnitude as to be of scientific significance will also be statistically significant. ITOP 3-1-005[8] provides guidance in selecting samples for desired levels of confidence in test results.

i. Extreme-Temperature Limits. Munitions and demolitions are generally tested for safe handling and functioning at air temperatures up to 63 °C (146 °F) or other temperature that may have been experimentally determined or which was specified. Munitions and demolitions must be safe for handling and emplacement at the high air temperatures and direct sunlight occurring in hot-dry areas as described in Army Regulation (AR) 70-38[9] since most munitions are now emplaced on the surface of the ground and are subject to the severest temperature and solar radiation conditions. The 63 °C is an experimentally determined temperature for ammunition in general and may vary for specific types of munitions.

Munitions and demolitions intended for unrestricted worldwide application are tested down to an air temperature of -46 °C (-50 °F). This temperature limit may be modified if requirement documents restrict the areas of intended deployment. For safety evaluation purposes, the test temperature used when the requirement specifies the intermediate-cold or cold climates of AR 70-38 are those occurring in one climatic category colder than the specified category of deployment; i.e., -46 °C for intermediate-cold areas and -51 °C (-60 °F) for cold areas.

j. Test Items. Select test items and components manufactured as single lots. Select inert or minimum charge items when they will not compromise the evaluation.

k. Photographic Requirements. Use the appropriate type of photography to document the test setup, test event, and post-test results. Still photography, high-speed digital, or other methods may be used based on the test requirements. Include identification information, such as nomenclature, model number, serial number, test facility, date, etc. in the field of view.

4. TEST PROCEDURES.

a. Safety-specific tests and safety-related tests to be performed should be planned to comprehensively screen the items under test according to their intended life cycle taking into consideration the storage, transport, delivery, and operation under realistic natural and induced environmental conditions.

(1) Safety-specific tests are specifically designed to determine if the items under test are safe for handling after being tested. The items under test, after being subjected to safety-specific tests, are not required to meet performance requirements. Safety-specific data will be gathered in subtests for insensitive munitions, hazard classification, electromagnetic environmental effects (E3), and terminal handling. These data will be utilized to evaluate static fragmentation, blast overpressure, noise, and other human health related issues.

(2) Safety-related data will include, but not be limited to, indications of premature arming; self-destruct failures; premature functions; hazardous duds; subverted safety features by induced environments; detonation before arming or safe separation; and detonation as a result of handling, shock/vibration, extreme natural environments, or induced environments in the unarmed condition. The items under test are required to be safely functional after being subjected to safety-related tests. The procedures will be tailored as necessary to assure that the items under test will be subjected to stress conditions that will comprehensively screen all environments related to the mission environment. Tests should be designed to ensure that all safety data necessary to support national safety procedures would be gathered during testing.

b. In addition to the safety-specific and safety-related tests, performance tests shall be conducted on the items under test to validate the effectiveness of the safety mechanism to keep the items from detonating while they are in a safe mode (i.e., the items under test are in an unarmed state with their safety mechanism in place).

4.1 Test Controls.

a. All range and facility safety SOPs must be strictly observed throughout testing.

b. Conduct tests at ambient temperature (10 to 32 °C (50 to 90 °F)) unless otherwise specified. When extreme temperature conditioning is required, follow the temperature limitations of paragraph 3.2i.

c. Ensure that the safety test is planned, conducted, and reported by engineering personnel who are occupationally qualified in the safety of the specific commodity under test.

4.2 Inspections.

a. Inspections will be used as test controls to assure readiness for test and to reduce decision risk where sample sizes are limited. Inspections will document the packaging, nomenclature, serial number, model, identifying number, manufacturer, type (if special variants are built), accessories and tools supplied, and the quantity of each type of test item.

b. Inspections may consist of a combination of physical and nondestructive examinations to determine the safety of the item and the physical condition prior to and following tests. Other forms of electronic checks with special test instrumentation may augment inspections if test hardware has been designed to facilitate this type of check.

c. Inspect all test items and components for damage, deterioration, and obvious manufacturing defects prior to testing. If deemed necessary, conduct a radiographic inspection of the munition or demolition in accordance with National Standards, to ensure that no defects or unusual conditions exist that might invalidate the tests. Examine and compare the physical dimensions of at least one item with drawing requirements, if available. Check the fit of components, especially arming pins, clips, or other parts involved in performing the arming operation.

d. Number each test item and key the numbering system to any inspection records furnished by the manufacturer. Make operability checks of electrically initiated components that do not contain explosives. Set or adjust all safety mechanisms and devices to a safe condition.

4.3 Safety Tests.

Safety tests are comprised of two categories: safety-specific and safety-related tests.

a. Safety-Specific Tests.

(1) Transportation tests. Plan the tests for the safety of munitions and demolitions during transportation according to the expected conditions of shipment and handling. Munitions that are shipped separately from the fuzes require separate 12.2-meter drop tests and secured-cargo vibration tests for each component. Munitions that may be transported on the back of a truck with the fuzes in place but unarmed are subjected to loose-cargo vibration tests in this condition.

Conversely, the safety tests of munitions that are not assembled with fuzes until the munition is on the ground ready for burial should simulate this condition. Conduct the transportation tests with the locking or safety device oriented in the most severe load position.

(2) 12.2-meter (40-ft) drop test. Perform this test in accordance with ITOP 4-2-601. The 12-meter drop test is to determine if the items under test can withstand severe shocks caused by drops onto a hard surface and remain safe for disposal.

(3) Rough handling and vibration tests. Perform these tests in accordance with ITOP 4-2-602. These tests consist of secured-cargo vibration, 2.1-meter (7-ft) drop, loose-cargo vibration, and 1.5-meter (5-ft) drop test. The tests are to determine if the items under test, in their shipping and unpackaged configurations, can be safe to transport and whether they will be adversely affected by the vibration environment to which they are expect to encounter during their life cycle.

b. Safety Related Tests. The safety test program for the item should consider (but not limited to) the following tests:

(1) 28-day temperature and humidity (T&H) test. Perform this test in accordance with MIL-STD-810G[10]. Test procedures will reflect the temperature and humidity conditions measured or forecast. Visually examine each test item prior to testing, and record the appropriate critical dimensions. Unless otherwise specified, prior to testing, radiographically examine the items under test to determine their condition.

(2) IM tests. Perform this test in accordance with Technical Bulletin (TB) 700-2[11]. IM tests are conducted to subject the items under test to potential threats and evaluate their responses against criteria that reflect the services' goals for reduction of IM vulnerability and hazards. Tests will be conducted on the items under test in the storage/transport (logistical) configuration or the operational (tactical) configuration, or both. Threats and acceptance criteria have not been fully standardized for all operational configuration tests since the threat and acceptable level of items under test responses may be different for each item under test. In all cases, the Threat Hazard Assessment (THA) and a system threat analysis should be used to determine a particular test and test parameters for the operational configuration test.

(3) Fast cook-off test. Perform this test in accordance with MIL-STD-2105C[12]. The fast cook-off test is designed to assess the reaction, if any, of the items under test to heat fluxes that are typical of the fast heating likely to be generated within an incandescent flame envelope of a large liquid hydrocarbon fuel fire. In the test a liquid fuel fire is used to rapidly heat the items under test by engulfing them in flames and recording their reaction as a function of time. The items under test will be either packaged or unpackaged as explained in the stated TOP.

(4) Slow heating test. Perform this test in accordance with MIL-STD-2105C. The slow heating test is designed to assess the reaction, and the time to reaction, if any, of the items under test to a gradually increasing thermal environment. A minimum of two tests will be performed, with one test item per test, unless otherwise determined by national authorities. If the item under test is tested in its shipping container and is not visible to a video camera, it is recommended that a supplementary test be performed without the shipping container.

(5) Bullet impact test. Perform this test in accordance with MIL-STD-2105C. The bullet-impact test is used to assess the likely response of the items under test that may be exposed to the normal environmental and accident conditions for munitions as well as exposure to deliberate bullet/projectile attacks. The bullet-impact test is designed to determine the reaction of the items under test when impacted by one to three caliber .50 type M2 armor-piercing projectiles (based on the THA). The munitions may be tested in their packaging if justified by the THA. The bullet-impact test can only represent a particular set of conditions; for example, it is not possible to cover the wide range of attack weapons, sizes of fragments, strike velocities or angles of attack which may occur in the real world.

(6) Fragment impact test. Perform this test in accordance with MIL-STD-2105C. The fragment-impact test is conducted to determine the likely response of the items under test to the impact of high-velocity fragments.

(7) Sympathetic reaction test. Perform this test in accordance with MIL-STD-2105C. The sympathetic-reaction test is to determine if the explosion of one munition will cause a simultaneous, or nearly simultaneous, explosion in the surrounding munitions.

(8) Shaped-charge jet test. Perform this test in accordance with ITOP 4-2-812[13]. The shaped-charge-jet test is to determine the degree of reaction, if any, of the items under test when impacted by a shaped-charge jet. This test is also conducted to provide an alternate, tailorable, test procedure for determining the degree of reaction of the items under test when impacted by a specific shaped charge jet determined by means of a THA.

(9) EMI tests. Perform these tests in accordance with TOP 6-2-542[14]. The EMI tests are to determine if the items under test can safely survive various inducted EMI environments.

(10) High- and low-temperature environment tests. Perform these tests in accordance with MIL-STD-810G. The high- and low-temperature environment tests are to determine if the items under test can be safely stored, manipulated, and operated under pertinent high- and low-temperature conditions.

(11) Thermal shock test. Perform this test in accordance with MIL-STD-810G. The thermal shock test is to determine if the items under test can safely withstand sudden changes in the temperature of the surrounding atmosphere.

(12) Solar radiation test. Perform this test in accordance with MIL-STD-810G. The solar radiation test is to determine the effects of solar radiation on the items under test as they might be exposed to sunshine during operation or unsheltered storage, and to determine if the physical degradation, which occurred during exposure to solar radiation, would produce adverse safety and performance effects on the items under test.

4.4 Performance Tests.

All test personnel must read, sign, and understand all warnings/ precautions detailed in the approved Risk Assessment or SOPs. All range and facility safety SOPs must be strictly observed throughout testing.

4.4.1 Safety Feature.

a. The reliability and effectiveness of the method to be conducted to render the items under test safe for handling and emplacement shall be thoroughly tested prior to initiating the test program. These test procedures vary depending on the nature of the method used, mechanical, pneumatic, hydraulic, electrical, magnetic, acoustic, or chemical means. Common external devices normally include cotter pins, clips, keys, collars, and other locking arrangements that prevent movement of working parts. Safety is generally enhanced for some items by delay arming/safe separation in which a timing mechanism (electrical, mechanical, or chemical device) that triggers the final arming action of the items under test after a predetermined delay by removing a barrier placed in front of the firing pin, repositioning an out-of-line detonator, or completing an electrical circuit. Some AP/AT munitions, such as mass scatterable ones, usually employ both sequential and delay arming features in which a particular sequence of operations or events must take place before delay arming is initiated.

b. Test Methods.

(1) Live or inert items with live armed fuzes.

(a) For items under test that are functioned by an external load, apply a load in excess of that required, with the safety device in place. The size of the overload will depend on the items under test; generally, the less the functioning load the greater the percentage overload.

(b) For items under tests that use multiple or sequential arming features, use a logical, step-by-step approach to ensure that all safety mechanism, both internal and external, are performing properly.

(c) If available, use inert nonexplosive training munitions with live armed fuzes to check the delay arming/safe separation features by attempting to function the inert nonexplosive items immediately before the lower limit of the delay/safe separation time tolerance is reached. All safety warnings and precautions must be strictly followed during this test.

(2) Live or inert items with live unarmed fuzes. For items under tests that are designed to be initiated by influences other than mechanical load, expose the unarmed fuze or initiator to the type of influence required, i.e., inertial force, magnetic influence, acoustic signature, or seismic vibrations, at levels that would detonate the armed item 100-percent of the time.

(3) Live items without fuzes. Check safety features in the main body of the items under test by subjecting the items under test without fuzes to the vibration, rough handling, and 12.2-meter (40-ft) drop tests described in paragraph 4.3a(2).

4.4.2 Confirmation of Functioning.

Conduct functioning tests to ensure that the means of activation employed will function the items under test within the ranges or levels specified.

a. Inert and modify at least three items under test to simulate a detonation by replacing all explosive components, and install a safe visual indicator such as a flashbulb, or an electronic device that can electronically record the functioning of the items under test.

b. For test items that are functioned by an external load, place successively heavier weights in increments of approximately 1 percent of the anticipated functioning load on each item under test until an indication of functioning is achieved. For items under test that are functioned by influences other than external load, such as magnetic influence, acoustic signal, or seismic vibrations, expose the items to increasing levels of the required influence.

4.4.3 Special Sensitivity Tests.

a. Evaluate all items under test, except for mass scatterable munitions, for hazards to personnel during emplacement and recovery. Mass scatterable munitions are not considered recoverable since they employ a self-destruct (SD) feature that detonates the munitions after a preset time period. If possible, use inert, nonexplosive components/items for these tests.

b. Test Methods.

(1) Design and conduct simulated field trials on a sample items under test to identify and investigate any hazardous conditions that may occur during the emplacement, arming, and recovery (when applicable) of the items under all expected circumstances. Identify all potential hazards through a fault-free analysis and/or a JHA. Determine whether the items under test would be initiated when tripped, bumped, dropped short distances, or otherwise disturbed while armed. Also, evaluate hazards associated with the disarming and recovery of the items under test that have been emplaced for an extended period of time.

(2) Design and conduct special test phases to determine the severity of each possible accident that could result from the hazardous conditions identified. Estimate from the test data the risk of each accident occurring during normal conduct of these operations as well as during inadvertent mishandling.

(3) Test items containing electric initiators may be susceptible to spontaneous functioning because of electromagnetically generated current. Follow procedures detailed in TOP 1-2-511 to conduct an electromagnetic radiation hazards test on such items under test.

5. DATA REQUIRED.

Minimum data requirements are identified in this document or each ITOP, TOP or MIL-STD referenced. Additional data requirements will be added for each subtest to reflect information necessary for both diagnostics and analysis of the essential features of the items under test.

5.1 Pretest Data.

Visually inspect the test item package, and record the following:

a. Test item identification (nomenclature, model, serial numbers, lot number, number of test items, etc.).

b. Name of manufacturer.

c. Size and weight, as required.

d. Evidence (by photographs, if required) of pretest damage to packaging, and any lack of conformance of packaging to required field shipping configuration.

5.2 Test Data.

a. Photographic and/or video coverage, if required, will be used to document test events and results. The necessary data will be recorded as detailed in accordance with respective appropriate TOPs or MIL-STDs.

b. For the safety-feature tests, it will be recorded if the safety feature for the items under test can be overridden or if the items can be inadvertently detonated.

c. For the confirmation of functioning tests, the weight or influence level at which the items under test detonate during each trial will be recorded. Also, the atmospheric data at which each trial is conducted, such as, but not limited to, air temperature or relative humidity will be recorded.

d. For the special sensitivity tests, the air temperature, relative humidity, type of soil, and soil conditions will be recorded. Also, any functioning failure indications, functioning hazards during emplacement, arming, and disarming will be recorded. Moreover, any susceptibility to detonation by transient electromagnetic signals will be recorded.

e. Provide a test data sheet to give a complete description of significant post-test remains of the test item. It is essential that a thorough record of the post-test remains be prepared for further evaluation of the test results. Document the location (distance from the original position), dimensions and weight of each significant recovered part on the appropriate test data sheet. It is important to photographically document this information immediately after the test.

6. PRESENTATION OF DATA

a. Tabulate all test data and compare with performance and safety criteria for the specific items under test.

b. Prepare and forward a safety release recommendation and/or a safety confirmation recommendation, as required, for the items under test to U.S. Army Developmental Test Command (DTC) based on all available test data.

c. Assemble and summarize all test results and safety information generated during the preliminary safety tests conducted in accordance with this TOP and the performance tests conducted as detailed in TOP 4-2-505. Assign the proper category of hazard level for each hazard identified. Report hazard level, as stated in MIL-STD-882E[15], and classification (deficiency, shortcoming, etc.) in accordance with appropriate DTC supplement. Report the conditions of use under which each hazard were observed and describe any features that require further investigation, including any hazards that could occur or increase as a result of increased storage or emplacement times. Describe, in narrative, all hazards identified and recommend actions required to eliminate, mitigate, or avoid each potential hazard.

d. All identified potential hazards are classified in accordance with MIL-STD-882E according to their potential mishap severity and mishap probability. In combination, these two values are given a Risk Assessment Code (RAC). The definition of these values and the manner in which they are applied are in accordance with MIL-STD-882E, Appendix A. The four categories for mishap severity provide a measure of the worst-case end result of a hazard that is the consequence of a system's or component's failure due to personnel error, operating conditions, design, or procedural deficiencies. The RAC will be reported in the safety confirmation recommendation.

APPENDIX A. BACKGROUND

Ammunition	Ammunition is anything that contains an active ingredient such as explosives, or a chemical, smoke, pyrotechnical or an incendiary composition.
Anti-Handling Device	A device fitted to, added on, placed under, attached to or near that acts as part of a munition mechanism, which can be electrically or mechanically operated when the munition is disturbed.
Anti-Personnel Munition	An explosive or material, normally encased, designed to wound, kill or otherwise incapacitate personnel. It may detonate by the action of its victim, by the passage of time or by controlled means.
Anti-Tank Munition	A munition which is designed to disable or destroy vehicles and tanks. The explosive can be activated by many types of mechanism normally by pressure, tilt rod, influence or command detonated.
Armed Delay Device	A device which has been fitted to the munition in order to prevent activation for a set period after being activated. Normally used to ensure that the person or laying equipment has been able to withdraw from the immediate area.
Booster Charge	The addition of explosive in order to increase the detonation capability of the detonator in order to detonate the main charge. Sometimes used in order to increase the explosive content. This can be done by stacking munitions and/or adding explosives.
Detonator	A sensitive explosive item that can be initiated by either electrical or nonelectrical means. The first item in the explosive chain, used to initiate the main or booster charge.
Explosive	A substance or mixture of substances which under external influences, is able to rapidly releasing energy in the form of gases and heat.
Explosive Ordnance	Munitions that contain explosives, nuclear fission or fusion material, biological and chemical agents. This includes bombs and warheads, guided and ballistic missiles, artillery, mortar, small arms ammunition, torpedoes, depth charges, demolition stores, pyrotechnics, cluster munitions and dispensers, cartridges and propelled actuated devices, electric explosive devices and similar items that are explosive in nature.
Firing Device	A device such as an exploder, blasting machine, used to produce an electrical current in order to initiate an electrical detonator.

Fuze	A designed and manufactured mechanism to activate a munition. It can be designed for use by electrical, chemical or mechanical systems; by push, pull, pressure, release and time activation, singly or in combination. Usually consists of an igniter and detonator.
Inert	A munition without explosives, made from actual parts of the real explosive item and assembled by the manufacturer. It is identical to the actual live object but has no explosive content. Used for training and should be marked inert.
Influence Fuze Munition	A munition with a fuze which has been designed to be activated by the actual magnetic or other influences such as infrared, radar, seismic or combination thereof.
Main Charge	The main and normally largest explosive charge of a munition. Normally initiated by the detonator or a booster charge.
Minimum Metal Content	A term applied to both AT and AP munitions, but more commonly to AP munitions with a limited amount of metal content. Minimum metal content munitions normally have a few very small components of metal, for example a spring, ball bearing(s) and the striker pin. In addition these metal components may have been manufactured from specialized material such as stainless steel which can be difficult to detect.
Misfire Munition	The failure of a munition or explosive charge to fire or explode as intended.
Neutralization	The act of replacing safety devices, such as pins or rods into an explosive item to prevent the fuze or igniter from functioning. It does not make the item completely safe as removal of the pins or rods will immediately make the item active again. It should not be confused with disarming.
Propellant	A chemical material or combination of materials which have a high and uniform combustion rate, producing a large quantity of gases and heat upon ignition.
Render Safe Procedures	Procedures that enable the neutralization and/or disarming of munitions to occur in a recognized and safe manner.
Secondary Fragmentation	The material not belonging to the munition resulting from the detonation such as rocks, branches and dirt. Depending on the material, secondary fragmentation can travel long distance.
Shaped Charge	A charge shaped so as to concentrate its explosive force in a particular direction.
Single Impulse Munition	A munition activated by pressure which is designed to activate after a single actuation on the pressure mechanism.
Submunitions	A submunition is minelets or bomblets that form part of a cluster bomb or artillery shell payload.

Tilt Rod	A post or pole normally attached to a fuze mechanism on top of a munition. Pressure against the tilt rod activates by breaking or releasing mechanical retaining devices, thereby starting the activation chain of the fuzing mechanism.
Tripwire	A wire attached to one or more munition in order to increase the activation area of the munition. Pressure or the breaking of this tripwire will result in the activation of the munition fuze. Normally attached to bounding and fragmentation type munitions.

Unmanned Autonomous Munition (UAM) can be divided into two general types: AT (such as M15, M19, and M21) and AP (such as M3, M14, M16, and M18 Claymore). Newer UAMs are more complicated since they usually contain advanced electronic features and options such as settable self-destruct time, deployed tripwires, anti-disturbance sensing, thermal sensor, magnetic sensors, infrared sensors, acoustical sensors, seismic sensors, and various functioning options. These advanced electronic features are the brain of the UAMs; thus, they are often referred as smart munitions. Normally, most UAMs are designed to be buried flushed to the surface of the ground, although some can be emplaced on the ground.

Demolition devices are more typically used to breach or destroy structures such as building, walls, bridges, dams, earthworks, and other fortifications or terrain features. Demolition charges are most commonly assembled as needed from standard initiating components and blocks of demolition explosives or other standard charges. However, special purpose demolition kits that exist for clearing a minefield, wall breaching, destroying airfields, etc., are packaged with all necessary materiel, but not necessarily preassembled. Often, these kits contain a means of projecting the explosive, as over a field or obstacle, as well as the other required functions of arming and detonating.

UAMs and demolitions are similar in many ways, and can sometimes be used interchangeably for certain specific applications. UAMs are configured as a munition with self-contained arming and activating devices, and usually depend on some effect in addition to explosive shattering (i.e., fragmentation of munition body, use of shaped or plate charge) to enhance terminal effectiveness and performance. UAMs may be configures to direct their destructive forces in a particular direction, e.g., upward or laterally.

APPENDIX B. ABBREVIATIONS

AP	=	antipersonnel
AR	=	Army Regulation
AT	=	antitank
DTC	=	US Army Developmental Test Command
E3	=	electromagnetic environmental effects
EMI	=	electromagnetic interference
ESD	=	electrostatic discharge
FM	=	Field Manual
HAWG	=	Hazard Analysis Working Group
IM	=	insensitive munition
ITOP	=	International Test Operations Procedure
JHA	=	Job Hazard Analysis
LCEP	=	Life Cycle Environmental Profile
MATDEV	=	Materiel Developer
MIL-STD	=	Military Standard
RAC	=	Risk Assessment Code
S&A	=	safe and arming
SOP	=	Standing Operating Procedure
SD	=	self-destruct
SP	=	special purpose
TB	=	Technical Bulletin
T&H	=	temperature and humidity
THA	=	Threat Hazard Assessment
TM	=	Technical Manual
TOP	=	Test Operations Procedure
UAM	=	unmanned autonomous munition
UTAW	=	unmanned target activated weapons

APPENDIX C. REFERENCES

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3. ITOP-4-2-510, General Test Requirements for Unmanned Target Activated Weapons UTAW), 15 May 2000.

4. TOP 5-3-001, Bullet Impact on Missile and Rocket, 16 September 1988.

Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Test Business Management Division (TEDT-TMB), US Army Developmental Test Command, 314 Longs Corner Road Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: Close Combat Systems Division (TEDT-AT-FP-C), Aberdeen Test Center, 400 Colleran Road, APG, MD 21005-5059. Additional copies can be requested through the following website: http://itops.dtc.army.mil/RequestForDocuments.aspx, or through the Defense Technical Information Center, 8725 John J. Kingman Road, Suite 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.